Renewable and Sustainable Energy Reviews 15 (2011) 657–664

Contents lists available at ScienceDirect

Renewable and Sustainable Energy Reviews

journal homepage: www.elsevier.com/locate/rser

Current status and analysis of renewable promotional policies in Indian restructured power sector—A review

Randhir Singh, Yog Raj Sood *

Electrical Engineering Department, National Institute of Technology Hamirpur (H.P)-177005, India

ARTICLE INFO

Article history:
Received 12 February 2010
Accepted 20 July 2010

Keywords:
Competitive electricity market
Power sector
Renewable energy sources
Renewable policy
Renewable tariff

ABSTRACT

Restructuring has changed the traditional mission and mandates of power utilities in complex ways, and had large impacts on environmental, social, and political conditions for any particular country. At the same time, new regulatory approaches are being found for reducing environmental impacts in restructured power sectors. India has a vast supply of renewable energy resources, and it has one of the largest programs in the world for deploying renewable energy based products and systems. So this paper attempts to review the various policies and measures undertaken by Indian government for promotion of renewable energy. The aim of this paper is also to review the current policy mechanisms, especially investment- or generation-based price-driven and capacity-driven mechanisms, ranging from investment incentives for the development of renewable energy projects, feed-in tariffs, production tax incentives, tradable green certificates, and their effects upon the prospects of encouraging as well as expanding the development of renewable energy in Indian restructured power sector. This will make renewable more attractive in the Indian future electricity market.

Contents

1. Introduction

During the nineties decade, many electric utilities throughout the world have forced to change their way of operation and business, from vertically integrated mechanism to open market

* Corresponding author. Tel.: +91 1972 254522; fax: +91 1972 223834.
E-mail addresses: randhirsoni@gmail.com (R. Singh), yrsood@gmail.com (Y.R. Sood).

1364-0321/$ – see front matter © 2010 Elsevier Ltd. All rights reserved.
doi:10.1016/j.rser.2010.07.057

system [1]. India also has followed the global change in power sector by establishment of the Regulatory Commissions in 1998 under the Electricity Regulatory Commissions Act 1998 (Central Law) to promote competition, efficiency and economy in the activities of the electricity industry and applied restructuring to Orrisa state electricity board firstly and after that to many other states [2]. Central Electricity Regulatory Commission (CERC) has a key role in rationalizing tariff of generating companies owned or controlled by the Central Government in consultation with State Electricity Regulatory Commission (SERC) [3]. At present India is sixth largest country in the world in electricity generation, having aggregate capacity of 149 GWs out of which 64% is from thermal, 25% from hydro, 3% from nuclear and the rest about 8% is from renewable energy sources (renewable in this paper refer to small hydro, wind, cogeneration and biomass-based power generation, and solar technologies) [4]. Although Indian power sector has experienced a four-time increased in its installed capacity—a jump from 30,000 MW in 1981 to over 149,391.91 MW [4] by May 2009 but still there is a huge gap in generation and demand in India hence need to be establish more generation plants preferably to be come from renewable sources by governmental as well as various private participation. The Indian power sector is predominantly based on fossil fuels, with about three-fifths of the country's power generation capacity being dependent on vast indigenous reserves of coal. But in few last decades Indian government has taken several steps to reduce the use of fossil fuels-based energy while promoting renewable generation. The policy as well as regulatory support to alternative energy has been encouraging [5] therefore. To combat climate change, there is an urgent need to make concerted efforts to reduce the carbon emission of the Indian power sector by encouraging greater efficiency and use of renewable sources of energy in the system in line with India's sustainable development priorities. India has huge potential of varied and complementary sources of renewable energy. The country aims to strengthen its energy security and independence by developing these resources. These include stringent norms for the construction and operation of energy generation equipment and increasing reliance on more advanced generation technologies in the field of renewables.

So there is a great need of renewable energy source in Indian power sector to meet future energy demand and remove GHG emission for environment protection. In this connection advent of the Electricity Act 2003 (E' Act 2003) [6] that was notified by the Ministry of Power in June 2003 with other policies National Electricity Policy [7] and National Tariff Policy [8] appears to be in the helm of affairs for the promotion of renewable energy at the state as well as to national level in India. The E' Act 2003 has assigned the responsibility of promoting Renewable Energy (RE) sources to various State Electricity regulatory commissions (SERCs) in their respective states. As per the Act, SERCs are required to encourage investment in RE by providing suitable measures for connectivity with the grid and specify a percentage of the total consumption of electricity in the area of a distribution license to be procured from RE sources. The National Tariff Policy that was notified by the Ministry of Power in January 2006, in continuation with the E' Act 2003 and the National Electricity Policy also emphasizes the importance of setting renewable energy quotas and preferential tariffs for renewable energy procurement by the respective SERCs in their restructured states power sector.

For inclusion of renewable energy sources in competitive electricity market India have adopted various support schemes and policies to promote renewable energy sources in their restructured power sector through its central and state regulatory commissions. Among these policies, Renewable Portfolio Standards (RPS/RPO) is state policies mandating a state to generate a percent of its electricity from renewable energy sources. Each state has a choice of how to fulfill this mandate using a combination of renewable energy sources, including wind, solar, biomass, geothermal, or other renewable sources. Feed-in laws are also the most important method for determining where, when, and how much renewable generating capacity will be installed [9]. Further more, The Indian government offers tariff support and tax breaks to promote renewable energy development. The renewable energy sector has benefited from a vibrant domestic capital market and increased activities in the areas of project finance, private equity investments and domestic and cross-border banking and funding. The government has accelerated the opening up of the energy sector to foreign investments that create chance to establish renewable market soon in India. Public enterprises like Indian Renewable Energy Development Agency (IREDA) Limited provide the institutional support for companies setting-up renewable energy projects. In view of these developments we believe that India is poised to become a world leader in renewable energy in near future. Investment support policy involves direct financial subsidies for building renewable energy generating capacity [10]. Apart from this, a 5-year tax holiday is also provided for power generation projects using renewable energy sources. As per the guidelines of the Ministry of New and Renewable Sources (MNRES), the state utilities encouraged renewable energy by offering remunerative price for power purchase and also providing facilities for banking. MNRES has drafted a Renewable Energy Policy that seeks to ensure that renewable energy technologies account for 10% of total power generation capacity in India by 2012.Similarly various other policies such as fiscal and financial measure, competitive bid renewable resources obligation, cost reduction policy and emission trading policy is also the key driver for promotion of renewable energy sources in Indian restructured power sector [11,12]. The organization of this paper follows the, Renewable energy policy directives, regulatory framework for renewable promotion, state policies and recommendation for future prospectus along with the concluded remarks.

2. Renewable energy policy directives

Several electricity policies in the last few years have talked about the need and priority to promote RE. Foremost amongst them is the Electricity Act (2003) which de-licensed stand-alone generation and distribution systems in rural areas [6]. The National Electricity Policy (2005) also stresses the need for urgent electrification [7]. The New Tariff Policy (2006) stated that a minimum percentage of energy, as specified by the Regulatory Commission, is to be purchased from such sources [8]. The details of directive released by Indian government to promote renewable energy are discussed in later sections.

2.1. Electricity Act 2003

EA-2003 provides that cogeneration and generation of electricity from renewable sources would be promoted by the SERCs by providing suitable measures for connectivity with grid and sale of electricity to any person and also by specifying, for purchase of electricity from such sources, a percentage of the total consumption of electricity in the area of a distribution licensee. Such percentage for purchase of power from these sources should be made applicable for the promotional tariffs to be determined by the SERCs at the earliest. Progressively the share of electricity from renewable energy sources would need to be increased as prescribed by State Electricity Regulatory Commissions. Such purchase by distribution companies shall be through competitive bidding process. Considering the fact that it will take some time before renewable technologies compete, in terms of cost, with

conventional sources, the Commission may determine an appropriate differential in prices to promote these technologies [6].

Moreover with advent of SERC in various states with restructured power sector every state has set Renewable portfolio obligation (RPO/RPS) in their respective state. With such type RE policy and the corresponding regulatory environment provide a framework for the pricing signals and projected viability and sustainability of renewables. The sections of EA-2003 which emphasis for promotion of renewable in India are give below:

(a) Section 86 (1) (e)—"The State Commission shall discharge the following functions, namely: promote cogeneration and generation of electricity from renewable sources of energy by providing suitable measures for connectivity with the grid and sale of electricity to any person, and also specify, for purchase of electricity from such sources, a percentage of the total Consumption of electricity in the area of a distribution license".
(b) Section 61 (h)—"The Appropriate Commission shall, subject to the provisions of this Act, specify the terms and conditions for the determination of tariff, and in doing so, shall be guided by the following, namely: the promotion of cogeneration and generation of electricity from renewable sources of energy".

Moreover E' Act 2003 provides guidelines for all three utilities of restructured power sector i.e. generation, transmission and distribution sides also for renewable promotion. In generation As per E' Act 2003 [Section 7, Any generating company may establish, operate, and maintain a generating station, without obtaining a license under this Act, provided it complies with the technical standards regarding connectivity with the grid. *Moreover as per* [Section 9 (1 & 2), A person may construct, operate, and maintain a captive generating plant and dedicated transmission lines for renewable as well other non-conventional energy sources. Such persons shall have right to open access to the transmission facilities, for carrying electricity from the captive plant to the destination of their own use.

In Distribution and Transmission side of Electricity, The main role of electricity E' Act 2003 may be outlined in the form as per [Section 42 (1 & 2)], The State Electricity Regulatory Commission (SERC) shall introduce open access in such phases and subject to such conditions (including the cross-subsidies and other operational constraints) as may be specified within 1 year of the appointed date by it. SERC shall specify extent of open access in successive phases, determine the wheeling charges, decide the surcharge in addition to the wheeling charges to meet current level of cross-subsidy (e.g. the industrial consumer cross-subsidizes the domestic ones) and also specify the manner in which such surcharge and cross-subsidies is progressively reduced and eliminated. Such surcharge shall not be levied in case of electricity being carried from captive power plant to the destination of own use.

Electricity Act 2003 gives the authority to SERC for preferential tariff for renewable energy development. SERC shall be guided in specifying the terms and conditions for determination of tariff as per *Section 61of* E' Act 2003.

SERC shall also discharge the following functions as per [Section 86(1)]: (1) Determine the tariff and wheeling charges of electricity; wholesale, bulk, or retail; within the State. (2) Promote cogeneration and generation of electricity from renewable sources of energy by providing suitable measures for connectivity with the grid and sale of electricity to any person. (3) Specify, for purchase of electricity from such sources, a percentage of the total electricity consumption in the area, from cogeneration and renewable sources of energy [13].

2.2. The National Tariff Policy 2006

The National Tariff Policy mandates each SERC to specify a Renewable energy Purchase Obligation (RPO/RPS) by distribution licensees in a time-bound manner. The Policy announced in January 2006 has the important provision for renewable promotion such as in pursuant to provisions of section 86 (1) (e) of the E' Act 2003, the Appropriate Commission shall fix a minimum percentage for purchase of energy from renewable sources taking into account availability of such resources in the region and its impact on retail tariffs. Such percentages for purchase of energy should be made applicable for the tariffs to be determined by the SERCs. It will take some time before non-conventional technologies can compete with conventional sources in terms of cost of electricity. Therefore, procurement by distribution companies shall be done at preferential tariffs determined by the Appropriate Commission. Such procurement by Distribution Licensees for future requirements shall be done, as far as possible, through competitive bidding process under Section 63 of the E' Act 2003 within suppliers offering energy from same type of non-conventional sources. In the long-term, these technologies would need to compete with other sources in terms of full costs of generation. The Central Commission should lay down guidelines within three months of its establishment for pricing non-firm power, especially from non-conventional sources, to be followed in cases where such procurement is not through competitive bidding [7,8].

2.3. National Rural Electrification Policies (NREP), 2006

The goals of NREP-2006, include provision of access to electricity to all households by the completion of year 2009, quality and reliable power supply at reasonable rates, and minimum lifeline consumption of one unit/household/day as a merit good by year 2012 [14]. For villages/habitations where grid connectivity would not be feasible or not cost effective, off-grid solutions based on stand-alone renewable based systems may be taken up for supply of electricity. Where these also are not feasible and if only alternative is to use isolated lighting technologies like solar photovoltaic, these may be adopted. However, such remote villages may not be designated as electrified. State governments have to be prepared and notify a rural electrification plan in their respective states, which should map and detail the electrification delivery mechanism. The plan may be linked to and integrated with district development plans. The plan should also be intimated to the appropriate commission. Moreover, Gram Panchayat shall involve in it and issue the first certificate at the time of the village becoming eligible for declaration as electrified. Subsequently, the Gram Panchayat shall certify and confirm the electrified status of the village as on 31st March each year [14,15].

According to NREP to achieve the 10% Renewable energy target through Renewable Purchase Obligations RPO set by the various SERCs, cognizant of its role in the promotion of RE, SERCs in many states have had been formulating encouraging policies to promote renewable energy. SERCs include preferential tariffs, RPO, reduction in contract load, banking and wheeling arrangements and guidelines for evacuation arrangement to renewable generators. Some SERCs have applied the RPO on the Open Access Consumers (OAC) and Captive Power Plant (CPP) consumers. Along with specifying a minimum RPO, certain SERCs have also set a ceiling for maximum power that can be purchased by the distributed companies (Disco's) from the RE sources in order to keep a check on increase in retail tariff due to higher power purchase costs. As per this policy for villages, where grid connectivity would not be feasible or not cost effective, off-grid solutions based on stand-alone systems may be taken up for supply of electricity based upon renewable so that every household gets access to electricity.

Moreover where neither stand-alone systems nor grid connectivity is feasible then only alternative is to use isolated lighting technologies like solar photovoltaic may be adopted [16].

3. Policy framework for promotion of renewables in India

The policy framework is the key to the success of renewable energy in any country. Policies aim at overall development and promotion of renewable energy technologies (RETs) and its applications. Policy initiatives encourage private sector to take part in renewable business as per provision of fiscal and financial incentives for a wide range of RE programs. Policies are largely financial, fiscal incentives or special directives aimed to encourage or enforced utilities to buy RE power, promoter companies to set up RE projects, equipment companies to manufacture RE equipment or private and government entities to undertake R&D relating to RE. In India, policy initiatives encourage domestic private investments with a provision of fiscal and financial incentives such as tax holidays, accelerated depreciation and duty rebates. At the central level, policy measures are administered through the Ministry of New and Renewable Sources (MNRES). The state governments contribute by making available infrastructural facilities for wheeling of power and buying power from renewable units. A comprehensive RE Policy for all-round development of the sector, encompassing all the key aspects, has been formulated by MNRES. The broad objectives envisaged in the draft policy are as meeting the minimum energy needs through RE, Providing decentralized energy supply in agriculture, industry, commercial and household sectors in rural and urban areas, and providing grid quality power. The policies targeting of 10% of additional grid power Generation capacity [17] to come from RE by 2012. Some of the policies and fiscal incentives in India for renewable energy developments are discussed in later sections.

3.1. Foreign investment policy

Foreign investors can enter into a joint venture with an Indian partner for financial and/or technical collaboration and for setting-up of RE-based power generation projects. Proposals for up to 100% foreign equity participation in a joint venture qualify for automatic approval and with this 100% foreign investment as equity is permissible with the approval of the Foreign Investment Promotion Board (FIPB). The Government of India encourages foreign investors to set up RE-based power generation projects on Build, Own and Operate (BOO) basis [18]. Government also encourages foreign investors to set up power projects based on other non-conventional energy sources also. Investors are required to enter into a power purchase agreement with the concerned state government [19]. There is No prior approval of the government is required to set up an industrial undertaking with Foreign Direct Investment (FDI) by Non-Resident Indians (NRIs). The Reserve Bank of India (RBI) has permitted Indian companies to accept investment under the 'automatic route' without obtaining prior approval from RBI [20] to set up such renewable based projects.

3.2. Foreign Investment Implementation Authority (FIIA)

The FIIA has been set up in the Ministry of Commerce and Industry to translate FDI approvals and implementations. It is headed by the Secretary (Department of Industrial Policy & Promotion) and is serviced by the SIA. FIIA would provide a one-stop after-care service to foreign investors by helping them to expedite approvals and clearances and to sort out operational problems with other government agencies. It will act as a single-point interface between the investors and government agencies including administrative ministries, state governments, Pollution Control Boards, Directorate General of Foreign Trade, regulatory authorities, tax authorities and Company Law Board among other and the approval holders have been requested to get in touch with respective officers in FIIA [21]. Hence the provisions in FIIA are directly or indirectly linked with renewable promotion.

3.3. Industrial policy

In industrial policy, MNRES is promoting medium, small, mini and micro enterprises for manufacturing and servicing of various types of RE systems and devices. For setting-up of an RE industry, industrial clearances as well as no clearance is required from Central Electricity Authority (CEA) for power generation projects up to Rs 1000 million. For RE power generation projects government is allowed five-year tax holiday and for RE equipment manufacturing, Soft loans are available through IREDA. Financial support is also available to RE industries for R&D projects in association with technical institutions. Private sector companies can set up enterprises to operate as licensee or generating companies. Customs duty concession is available for RE spares and equipment, including those for machinery required for renovation and modernization of power plants. They are also expected to convey the government's decisions on applications filed and for assisting entrepreneurs to set up projects and monitoring implementation [15].

3.4. Joint ventures policies

Joint ventures are a financial as well as technical collaboration and they are used by foreign investors as it provides maximum visibility and presence in the country. A foreign investor can enter into a joint venture not only for manufacturing RE products and systems, but also in setting-up RE-based power generation projects. Usually joint ventures are in the form of takeovers or strategic alliances with the existing reputed companies with a niche market. A foreign investor can set up a liaison office as an intermediate step before entering into a joint venture.

3.5. Policies for small-scale industries

Renewable energy technologies (RETs) provide one of the best options for first-generation entrepreneurs and small-scale industries (SSIs). MNRES and Indian Renewable Energy Development Authority (IREDA) have drawn up financial and fiscal incentives to suit technology of varying sizes and scales for small- and medium-sized investors and entrepreneurs. An industrial undertaking is defined as a small-scale unit if the investment in fixed assets in plant and machinery does not exceed Rs. 10 million. Small-scale industries (SSIs) are not permitted more than 24% equity in its paid up capital from any industrial undertaking, foreign or domestic. SSIs are free to manufacture any item including those notified as exclusively reserved for the small-scale sector and these are free from locational restrictions, which are mandatory for large industries. The National Small Industries Corporation (NSIC), under the Ministry of Industry and Commerce, also provides assistance through a number of schemes, which include financial and marketing services, technical services and training, and exports facilitation [22].

3.6. Incentives for investing in RETs

MNRES provides financial incentives, such as interest and capital subsidy and Soft loans are provided through: IREDA, a public sector company of the Ministry, Nationalized banks and other financial institutions for identified technologies The government also provides various types of fiscal incentives for the RE sector, which include: (a) Direct taxes—100% depreciation in the first year of the installation of the project, (b) Exemption/reduction

in excise duty, and (c) Exemption from Central Sales Tax, and customs duty concessions on the import of material, components and equipment used in RE projects Under Income Tax Rules following concessions are available to the non-conventional energy sector:

(1) Section 32: Accelerated 80% depreciation on specified RE-based devices/projects.
(2) Section 80 IA: Industrial undertakings set up in any part of India for the generation or generation and distribution of power at any time. A 100% deduction is allowable from profits and gains for first 5 years and thereafter 30% of the profits and gains. This benefit can be availed for any 10 consecutive assessment years failing within a period of 15 assessment years beginning with the assessment year in which that industrial undertaking begins generation or generation and distribution of power.
(3) Section 115 J: Exemption from MAT to industrial undertakings on profits derived from the business of generation and distribution of electricity.
(4) Section 80JJA: Hundred percent deduction in respect of profit and gains from business of collecting and processing biodegradable wastes.

3.7. Feed-in tariff policy

Feed-in tariffs are a generic description of a policy that pays a price, a "tariff", for the electricity generated by renewable sources of energy that is "fed" into or sold to the grid. They are sometimes called Renewable Tariffs, Advanced Renewable Tariffs, Renewable Energy Payments, and more generally, feed laws Renewable tariffs are the world's most successful policy mechanism for stimulating the rapid development of renewable energy. They are also transparent, comprehensible, and equitable: the door is open to everyone, from farmers to homeowners, from small to large businesses, from independent power producers to cooperatives. Everyone can participate. The terminology describing feed-in tariffs and the way they are viewed relative to electric utility regulation has changed over the years. The terminology has changed in part because of changes in how the tariffs are determined and whether there is only one tariff offered, or many.

Feed-in tariffs vary in design from country to country. The policies should establish different tariffs for different technologies, usually related to the cost of generation, for example distinguishing between off-shore and onshore wind power. Some policies also differentiate tariffs by location and region, year of plant operation, and operational season of the year. Tariffs for a given plant may decline over time, but typically last for 15–20 years. Some policies provide a fixed tariff while others provide fixed premiums added to market- or cost-related tariffs (or both, as in the case of Spain). The development stage of feed-in tariff is Advanced Renewable Tariffs (ARTs) in which Feed-in Tariffs (FITs) differentiated by technology, size, application, and sometimes resource intensity. There is one price or tariff paid for wind energy, another price for solar, and so on. Tariffs within each technology are also differentiated by project size or, in the case of wind energy, by the productivity of the resource.

In Advanced Renewable Tariffs, the individual tariffs are determined by the cost of generating the electricity plus a reasonable profit for the producer. The market then functions to determine how much, where, and by who renewable will be developed. Tariffs for new projects are also subject to periodic review to determine if the program is sufficiently robust to produce the desired growth in renewable energy. Public policy makes a determination that a particular resource is desired, such as renewable source, then the tariff necessary to bring on the amount of the technology desired determined, and the rate posted and made available to all comers. In summarize form, modern policies of Advanced Renewable Tariffs require, Priority access to the grid, Priority purchase of generation from renewable resources, and Differentiated tariffs based on the cost of generation plus a reasonable profit Differentiating tariffs breaks any remaining link between the rates paid for renewable energy and the cost of conventional generation which renewable resources offset. This is most obvious in the case of solar PV.

As feed-in tariff is place specific as well as source specific so in each of the electricity regulatory commission adopt different tariff for different renewable sources in India. Reason for this difference is availability of source such as small hydro availability is Himalayas region (Himachal Pradesh, Uttarakhand, etc.) and wind power available in state such as Tamil Nadu, hence, differential tariff is necessary for renewable power development. The SHP tariffs [16] adopted by some of SERCs in India are given in Table 1.

3.8. Renewable portfolio standard (RPS/RPO)

A Renewable Portfolio Standard is a policy instrument that ensures renewable energy promotion in a way that is compatible

Table 1
Feed-in tariff for small hydro power in India [16].

State	Small hydro
Andhra Pradesh	• Rs. 2.60/Unit for the first year. • Royalty charges will be paid by APTRANSCO and Disco's to Govt. of A.P. (GoAP). • Rs. 0.39/Unit up to 5 years. • Rs. 0.78/Unit beyond 5 years and up to 10 years. • Rs. 1.17/Unit beyond 10 years.
Karnataka	• Rs. 2.80/Unit for the first year with no escalation. • No Royalty charges.
Uttar Pradesh	• Rs. 3.39/Unit. • Royalty charges will be paid by distribution licensees to Government of UP (GoUP).
Uttaranchal	• For projects less than 1 MW and for less than 25 MW, tariffs will be set according to regulation and on case-to-case basis. For projects greater than 1 MW the guiding regulation is "tariff will be will be determined as the weighted average of power allocated to the state from central government stations. " All other related provision remains unchanged as per the regulation of 2004. If any generating company wants to get the tariff determined in accordance to the regulation of 2004 then he could approach the commission.
Maharashtra	• Rs. 2.84/Unit in the first year, which increases by Rs.0.03/Unit every year till the debt repayment, is over i.e. in the10th year. • The tariff shall remain constant at Rs. 3.11/Unit between the 10th year and the 15th year after which it again increases annually at a constant rate of Re 0.03/Unit. • Royalty charges are passed through.
Himachal Pradesh	• Rs.2.50/Unit with the base year 2001. Provided that the tariff shall be indexed at 50% of the annual inflation rate of the Consumer Price Index. The inflation up to 50% shall be absorbed by the renewable energy generator and 50% inflation shall be added to the base rate (as given in the 'Draft Regulations for power procurement from renewable sources, November, 2005')

Table 2
RPS status in India.

State	RPS (%) specified	Tariffs fixed by commissions in Rs./kWh	Validity of tariff (year)	Charges for captive users	Cross-subsidy surcharge for sale to 3rd party in Rs./kWh
Tamil Nadu	10%	2.90 (fixed)	20	10% (includes 5% for banking if applicable)	1.08
Karnataka	7–10%	3.40 (fixed)	10	–	0.79
Maharashtra	3–6%	3.50 + escalation of 0.15 on an annual basis	13	–	Nil
Rajasthan	7.5%	3.59 + escalation of 0.02 for the first 12 years + escalation of 0.01 for the balance 8 years	20	10%	0.27
Andhra Pradesh	5%	3.37 (fixed)	5	–	1.81
Madhya Pradesh	10%	4.03 reducing at 0.17 per year till the 4th year; subsequently fixed at 3.36 till the 20th year	20	2% plus transmission charge	1.03
Kerala	3%	3.14 (fixed)	20	5%	Not notified
West Bengal	3.8%	4.00 (fixed, to be used as a cap)	Flexible	2%	Not notified
Gujarat	2%	3.37 (fixed)	20	4%	1.00
Haryana	3–10%	4.08 (with 1.5% escalation per year)	5	2%	Nil

with competitive electricity markets. An RPS is a policy instrument that ensures that a minimum amount of renewable energy is included in the portfolio of resources serving the country. Many SERCs, including those of Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra and Orissa, have already fixed this quota. Those of Kerala, Rajasthan, Tamil Nadu and Uttar Pradesh are in the process of finalizing this quantum share of renewable energy. Hence, an effectively designed RPS will ensure renewable energy promotion in a competitive market set-up. However, it would be imperative to define 'eligible renewable energy credit' as a certificate of proof, certified by the regulator, that one kilowatt-hour of electricity was generated by an eligible renewable energy resource. Further, the tradable nature of such credits should be given deep thought and encouraged, so that the renewable energy credit may be sold or exchanged by the person to whom issued, or by another person who acquires the credit. This will ensure healthy and competitive promotion of renewable energy based electricity generation that is imperative for a sector that is badly in need of reform. The RPS, fixed tariff by various SERCs, tariff validity duration and subsidy to Third party for transmission of renewable power in India is given in Table 2.

4. State polices for promotion of renewable

The Electricity Act 2003 provides that cogeneration and generation of electricity from renewable sources would be promoted by the SERCs by providing suitable measures for connectivity with grid and sale of electricity to any person and also by specifying, for purchase of electricity from such sources, a percentage of the total consumption of electricity in the area of a distribution licensee. More than 17 States of India have so far announced policies of inviting private sector participation and allowing wheeling, banking and buyback of electricity to attract private sector entrepreneurs in field of renewable generation. Regulatory Commissions in 4 states namely Andhra Pradesh, Maharashtra, Karnataka and Madhya Pradesh have declared the policies for wind power development. SERCs in other States are determining tariffs for the sale of electricity based on renewable energy. Some states are also awarding the projects based on competitive bidding process for the rate for purchase of electricity. To understand the state government policies for renewable energy, firstly we have to understand policies terms as wheeling, Banking, Bay-back in the later sections.

4.1. Wheeling

Wheeling is the transmission of power from a seller to a buyer through the network owned by a third party." The wheeling utility is paid for its service and for meeting the losses. It might require rescheduling its own generation, because of wheeling transactions. The important issues are normally related to sharing of benefits and pricing of these transactions. In power sector energy for development of renewable energy, government gives the subsidy for power producer and paid transmission charges to transmission owner.

4.2. Bay-back

If you can generate electricity for your own home from renewable energy sources you can sell any excess renewable energy back to Synergy. Most home renewable energy systems (e.g. photovoltaic arrays, wind turbines or micro-hydro power systems) will produce more energy than is required at certain times during the day and less than is required at other times. Customers on this scheme are billed for their net import and credited for their net export of electricity over a billing period. Residential Customers are offered renewable energy buyback rates equal to their selected electricity purchase rates. This means that Synergy will buy power from the customer at 10/11ths of the price Synergy sells to the customer. For multi-residential premises, each premise must be connected to the renewable energy system of a size equivalent to more than 500 W and up to 5 kW to be eligible [22].

Changes to metering requirements may also be required to allow eligible customers, at multi-residential premises, to participate. The scheme is also open to non-profit organizations and to educational institutions (schools, universities, etc.). However, as Smart Power is not available to these sectors, only the buyback rate equivalent to the applicable tariff rate is available. Buy–back rate provided by various SERC are given in Table 3 as shown below

4.3. Extra incentives for RES development

Beside RPS, green certificate, wheeling, banking, buy back policies available in various states, the Government of India has also been providing various other fiscal and financial incentives such as capital subsidy, interest subsidy and depreciation related income tax benefits with the objective of promoting development and dissemination of renewable energy technologies in the country. These financial incentives have, however, changed from time to time in their type, magnitude, scope and even geographical coverage. In some cases, the state governments have also been providing more special additional incentives to renewable [17].

For the case of wind generation, the Government of India is promoting commercial wind power projects in various states across the country such as Tamil Nadu, Maharashtra, Karnataka, Gujarat, Rajasthan, Madhya Pradesh and Andhra Pradesh due to

Table 3
Bay-back rate in Rs./Unit in India.

S. No.	State/UT	Wind power	Small hydro power	Biomass power
1	Andhra Pradesh	3.37 fixed for 5 years	2.69 (2004–2005)	2.63 (2005–2006) Esc @ 1% for 5 years
2	Chhattisgarh	–	–	2.71 (2005–2006)
3	Gujarat	3.37 fixed for 20 years	–	3.00 No escalation (Esc.).
4	Haryana	–	2.25 (94–95)	4.00—biomass 3.74—cogen. Esc. @ 2% (base 2007–2008)
5	Himachal Pradesh	–	2.50	–
6	Jharkhand	–	–	–
7	Karnataka	3.40 fixed for 10 years	2.90	2.74—cogen. 2.88—biomass Esc @1% for 10 years (base 2004–2005)
8	Kerala	3.14 fixed for 20 years	–	2.80 (2000–2001) Esc @ 5% for 5 years
9	Madhya Pradesh	3.97–3.30	2.25	3.33–5.14 Esc. @ 0.03–0.08 for 20 years.
10	Maharashtra	3.50 Esc @ 0.15 per year	2.25 (1999–2000)	3.05—cogen. 3.04–3.43—biomass Esc @ 1% for 13 years
11	Punjab	–	2.73 (1998–1999)	3.01 (2001–2002) Esc @ 3% for 5 years limited to 3.48
12	Rajasthan	2.91 Esc @ 0.05 for 10 years	2.75 (98–99)	3.60–3.96 Water–air cooled
13	Sikkim	–	–	–
14	Tamil Nadu	2.70 (fixed)	–	2.73 (2000–2001) Esc @ 5% for 9 years
15	Uttar Pradesh	–	2.25	2.86—existing plants 2.98—new plants Esc @ 0.04/year

Table 4
Policy framework and key incentives for RE technologies.

Technology	Policy framework	Key incentives
Wind power	• Fiscal and financial incentives • Wheeling, banking, Third party sale, buyback facility by states • Capital subsidies and sales tax incentives in certain states	• Detailed project report preparation at discounted price • Capital grant for setting-up projects in North Eastern states • Financial support for renovation, modernization and
Small hydro power	• Fiscal and financial incentives • Wheeling, banking, Third party sale, buyback facility by states • Capital subsidies and sales tax incentives in certain states	• Capacity up-rating of old SHP stations • Financial support for development/up gradation of water mills • Soft loans from IREDA for setting-up so SHP projects up to 25 MW capacity
Biomass power	• Enactment of favourable policy regimes at the state as well as the Central levels buyback/Wheeling/Banking of generated electricity by the SEBs • Incentives in the form of sales tax exemptions, equity and grants, etc.	• Interest subsidy for commercial biomass power projects • Up to 3% interest subsidy for biomass/bagasse cogeneration (commercial projects) • Capital subsidy for cogeneration projects in Joint Venture model/IPP mode in cooperative/public sector sugar mills • Financial assistance under the National Biomass Resource Assessment Program (NBRAP) • Energy from waste

existence of huge potential of renewable into these states. According to the GoI, it will provide incentives for the development of these projects. The incentives include a concessional import duty for wind electricity generator sub-systems, excise duty exemption, 10 years tax holiday on wind power projects, benefit of accelerated depreciation and term loans from Indian Renewable Energy Development Agency (IREDA). Beside these, Indian government also plans to assist in identification of more potential locations by carrying out wind resource assessment studies. The detail summery of renewable energy promotional policies for different renewable energy sources are given in Table 4.

5. Conclusions and recommendations

It may be concluded that renewable energy development is of great importance from the point of view of long-term energy supply security, decentralization of energy supply particularly for the benefit of the rural population, environmental benefits and sustainability in power sector also. For renewable development in India, the renewable energy program has been in existence for more than three decades, but a market for renewable energy technologies still need to be exists. Though a manufacturing base has been set up and an infrastructure created to support RET design, development, testing and deployment, commercial demand for these technologies still remains low.

Based on the analysis of various polices, it is suggested that for faster development of renewable energy technologies (RETs), following recommendations are necessary to implement.

- A strong need to improve reliability of technologies and introduce consumer-desired features (in terms of services and financial commitments) in the design and sales package.

- Although renewable energy sources are comparatively more expensive than conventional fuels, but they can be used in distributed generation and local distribution networks to counterbalance the transmission and distribution (T&D) losses incurred by states depend on government support for development.
- Renewable energy strategy should form a part of energy sector regulatory framework.
- Incorporation of renewable energy strategy into development programs will promote its decentralized applications.
- The government policies should encourage more private participation and industry collaboration in R&D for rapid commercialization of RETs and in market infrastructure development.
- Renewable energy strategy needs to be integrated with liberalization of energy markets and withdrawal of direct government interventions in energy sector.
- Renewable energy deployment could be enhanced from energy services delivery perspective.
- Public-private role in renewable energy development needs to be redefined.
- Need to construct market-based energy policies that provide a competitive market framework, and may internalize externalities in terms of energy security, environmental protection and economic efficiency for effective promotion of renewable.

References

[1] Sood YR, Padhy NP, Gupta HO. Wheeling of power under deregulated environment of power system—a bibliographical survey. IEEE Trans Power Syst 2002;17(3):870–8.

[2] Anoop Singh. Power sector reform in India: current issues and prospectus. Energy Policy 2006;34:2480–90.

[3] Bhakar R, Padhy NP, Gupta HO. State of art of the regulatory process in India. In: IEEE Power and Energy Society general meeting—conversion and delivery of electrical energy in the 21st century; 2008.p. 1–8.

[4] Ministry of Power. Available: http://www.powermin.nic.in [online].

[5] The Energy and Resources Institute (TERI). Power sector to focus on role of regulators and utilities for combating climate change. February 09, 2009. Available: http://www.businesswireindia.com [online].

[6] Government of India. The Electricity Act, 2003. New Delhi: The Gazette of India, Extraordinary, 2003; June 2003.

[7] Government of India. Tariff policy. 6th January, 2006. Available: http://www.powermin.nic.in [online].

[8] Government of India. National Electricity policy and plan. Available: http://www.powermin.nic.in [online].

[9] Electricity, Electricity Feed Laws. Feed-in tariffs, and advanced renewable tariffs. Available: http://www.wind-works.org [online].

[10] Public Benefits Funds for Renewable Energy. Available: http://www.dsireusa.org [online].

[11] Renewable Energy Policies and Market Developments. Available: http://www.ecn.nl/docs/library/report/2003/c03029.pdf.nic.in [online].

[12] Singh R, Sood YR. Policies for promotion of renewable energy sources for restructured power sector. IEEE Third International Conference on Electric Utility Deregulation and Restructuring and Power Technologies, DRPT 2008. 6–9 April 2008, p. 1–5.

[13] Government of India. Electricity Act 2003 vs. Additionality for grid connected renewable energy (RE) projects. Available: http://www.teriin.org [online].

[14] Anare Matakiviti. Energy Adviser GOI National Energy Policy and Rural Electrification Policy. 5–7 April 2006.

[15] Ministry of New and Renewable Energy source (MNERS). Policy support for grid interactive renewable power. Available: http://www.mnes.nic.in [online].

[16] Various Indian states electricity regulatory commissions websites.

[17] Government of India National Knowledge Commission Science and Environment. Policies for renewable energies/biomass in India.

[18] Ghosh Debyani, Shukla PR, Garg Amit, Ramana PV. Renewable energy strategies for Indian power sector. Available source: http://www.decisioncraft.com [online].

[19] Indian Investment Center. Foreign Direct Investment Policy & Business Opportunities.

[20] Laxman Kumar Behera. India needs a liberal FDI policy for its defense industry. January 2009. Available: http://www.indiastrategic.in [online].

[21] The Financial Express. India seeks FDI in renewable energy SEZ. Jun 27, 2008. Available: http://www.financialexpress.com [online].

[22] MNRES. Review of government of India policies for promotion of renewable and biomass energy utilization in India. Available source: http://www.nri.org [online].



Randhir Singh was born in Yamuna Nagar (Haryana), India. He obtained his B.Tech. in electrical engineering from Kurukshetra University Kurukshetra and M.Tech. in electrical engineering (power system) from NIT, Kurukshetra Haryana (India) in 2002 and 2005 respectively. Presently he is pursuing his Ph.D. in Electrical Engineering Department at NIT, Hamirpur. His interest researches are deregulation of power sector, congestion management, Renewable energy Sources.



Dr. Y.R. Sood obtained his B.Sc. degree from P.U. Chandigarh in 1980. He received his B.E. degree in electrical engineering with "Honours" and M.E. in power system from Punjab Engineering College Chandigarh (U.T.), in 1984 and 1987 respectively. He has obtained his Ph.D. from Indian Institute of Technology (IIT), Roorkee in 2003. He joined Regional Engineering College Kurukshetra in 1986. Presently he has been working as professor in the Electrical Engineering Department of National Institute of Technology, Hamirpur (H.P.) India since January 2005. He has published a number of research papers. He has been honored with many awards including "The Union Ministry of Energy, Department of Power Prize" for publication of one of his research paper in the journal of the Institution of Engineers (India). Recently, honored with "Decree of excellence in Education" by The Director General, International Biographical Centre (IBC), Cambridge. His research interests are in the area of power sector restructuring and deregulation, power system optimization, high voltage engineering, condition monitoring of transformers and non-conventional sources of energy.